

IN THE UNITED STATES PATENT AND TRADE MARK OFFICE

Applicant: Thakar, et al.
Serial No.: 09/939,259
Filed: 08/24/01
For: POLYSILICON PROCESSING USING AN ANTI-REFLECTIVE DUAL LAYER HARDMASK FOR 193 NM LITHOGRAPHY

Examiner: Edgardo Ortiz
Docket: TI-32822

REQUEST FOR RECONSIDERATION
OF PETITION UNDER 37 CFR 1.47(a)

July 25, 2002

BOX DAC
Assistant Commissioner for Patents
Washington, D.C. 20231

MAILING CERTIFICATE UNDER 37 C.F.R. 1.8 (A)

I hereby certify that the above correspondence is being deposited with the U.S. Postal Service as First Class Mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231 on July 25, 2002.

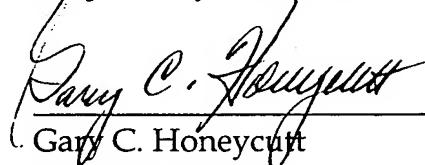
Ginger Cox

Sir:

Responsive to the Dismissal of Applicant's Petition under 37 CFR 1.47(a), dated June 5, 2002, a Declaration of Gautam V. Thakar is submitted herewith to corroborate the refusal of inventor Laaksonen to sign the Declaration and Power of Attorney (Rule 64).

Mr. Laaksonen's home address is 9030 Markville Drive, Apartment 2726, Dallas, Texas 75243, and has not changed since the Application was filed.

Respectfully Submitted,


Gary C. Honeycutt

Reg. No. 20,250
Attorneys for Applicant

Godwin Gruber, P.C.
Renaissance Tower
1201 Elm Street, Suite 1700
Dallas, Texas 75270-2084
Tel - (214) 939-4400
Fax - (214) 760-7332



UNITED STATES PATENT AND TRADEMARK OFFICE



GCH
Commissioner for Patents
United States Patent and Trademark Office
Washington, D.C. 20231
www.uspto.gov

Paper No. 8

TEXAS INSTRUMENTS INCORPORATED
P O BOX 655474
M/S 3999
DALLAS TX 75265

COPY MAILED

SEP 12 2002

OFFICE OF PETITIONS

In Application of
Thakar, et al.
Application No. 09/939,259
Filed: August 24, 2001
Attorney Docket No. TI-32822
Title: POLYSILICON PROCESSING
USING AN ANTI-REFLECTIVE DUAL LAYER:
HARDMASK FOR 193 NM LITHOGRAPHY

DECISION ACCORDING STATUS
UNDER 37 CFR 1.47(a)

This is in response to the renewed petition under 37 CFR 1.47(a), filed July 31, 2002 (Certificate of Mailing dated July 25, 2002).

The renewed petition under 37 CFR 1.47(a) is GRANTED.

The above-identified application was filed on August 24, 2001. On October 10, 2001, applicant was mailed a "Notice to File Missing Parts of Nonprovisional Application - Filing Date Granted," requiring an executed oath or declaration (and a surcharge for its late filing). This Notice set a two-month period for reply.

In reply, applicant filed a petition under 37 CFR 1.47(a) on February 7, 2002, and paid the surcharge for late filing of the declaration. To make timely this reply, applicant obtained a one month extension of time and included a Certificate of Mailing dated January 10, 2002. Accompanying the petition were, *inter alia*, (1) a declaration executed by inventors Gautam Thakar, Cameron Gross, and Eric Joseph, with the signature block for inventor Reima T. Laaksonen left blank; and (2) a statement of facts from attorney Gary Honeycutt, explaining that Laaksonen refused to sign the declaration because his name was not listed first.

A grantable petition under 37 CFR 1.47(a) requires: (1) proof that the non-signing inventor cannot be reached after diligent effort or refuses to sign the oath or declaration after having been presented with the application papers (specification, claims, drawings, oath or declaration); (2) an acceptable oath or declaration in compliance with 37 CFR 1.63; (3) the petition fee; and (4) a statement of the last known address of the non-signing inventor.

RECORDED

SEP 17 2002

BEN KROGER

However, the February 7, 2002 petition was dismissed in a decision mailed on April 5, 2002. Petitioner had not submitted any evidence or details regarding Laaksonen's refusal to sign the declaration. In addition, petitioner did not supply a statement of the last known address of non-signing inventor Laaksonen.

On renewed petition, petitioner submitted a "Declaration of Gautam V. Thakar", in which Thakar set forth that Laaksonen made an oral refusal to sign the declaration at a meeting of all the inventors on or about December 11, 2001. In addition, the renewed petition included a statement of the last known address of Laaksonen.

The declaration filed February 7, 2002 and the petition have been reviewed and found to be in compliance with 37 CFR 1.47(a). This application is hereby accorded Rule 1.47(a) status.

As provided in 37 CFR 1.47(c), this Office will forward notice of this application's filing to the non-signing inventor at the address given in the petition. Notice of the filing of this application will also be published in the Official Gazette.

The file does not indicate a change of address has been submitted, although the address given on the petition differs from the address of record. If appropriate, a change of address should be filed in accordance with MPEP 601.03. A courtesy copy of this decision is being mailed to the address given on the petition; however, the Office will mail all future correspondence solely to the address of record.

The application file is being returned to the Office of Initial Patent Examination for continuation of pre-examination processing.

Telephone inquiries regarding this decision should be directed to Petitions Attorney Cliff Congo at (703) 305-0272.

E. Beverly Flanagan
Beverly M. Flanagan
Supervisory Petitions Examiner
Office of Petitions
Office of the Deputy Commissioner
for Patent Examination Policy

cc: Godwin Gruber, P.C.
801 East Campbell Road
Suite 655
Richardson, Texas 75081

JGCH



UNITED STATES PATENT AND TRADEMARK OFFICE

COMMISSIONER FOR PATENTS
 UNITED STATES PATENT AND TRADEMARK OFFICE
 WASHINGTON, D.C. 20231
www.uspto.gov

APPLICATION NUMBER	FILING/RECEIPT DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NUMBER
09/939,259	08/24/2001	Gautam V. Thakar	I-32822

CONFIRMATION NO. 2177

FORMALITIES LETTER



OC000000006877088

23494
 TEXAS INSTRUMENTS INCORPORATED
 P O BOX 655474, M/S 3999
 DALLAS, TX 75265

Missing parts 12/10/01 ✓

Date Mailed: 10/10/2001 ✓

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given TWO MONTHS from the date of this Notice within which to file all required items and pay any fees required below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The oath or declaration is unsigned.
- To avoid abandonment, a late filing fee or oath or declaration surcharge as set forth in 37 CFR 1.16(l) of \$130 for a non-small entity, must be submitted with the missing items identified in this letter.
- The balance due by applicant is \$ 130.

A copy of this notice MUST be returned with the reply.

Customer Service Center

Initial Patent Examination Division (703) 308-1202

PART I - ATTORNEY/APPLICANT COPY

RECEIVED

OCT 1 2 2001

BEN KROGER

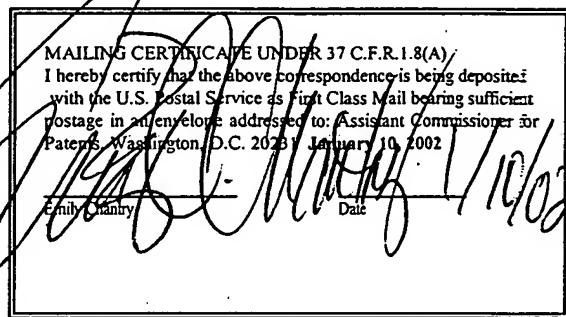
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Thakar, et al. Art Unit: 1765
Serial No.: 09/939,259
Filed: 08/24/01 Docket: TI-32822
For: POLYSILICON PROCESSING USING AN ANTI-REFLECTIVE DUAL LAYER
HARDMASK FOR 193 nm LITHOGRAPHY

PETITION FOR EXTENSION OF TIME

January 10, 2002

Assistant Commissioner
for Patents
Washington, D.C. 20231



Sir:

Pursuant to 37 CFR 1.136(a), Applicant(s) respectfully petitions the Commissioner for an extension of the shortened statutory period for response in the above-identified Application.

The fee for this extension is indicated below:

- One Month (\$110)
- Two Months (\$390)
- Three Months (\$890)
- Four Months (\$1,390)

Please charge the fee to **deposit account no. 20-0668**. Any further necessary extension of time is hereby requested. Charge any and all fees to **deposit account no. 20-0668**. An original and two copies of this sheet are enclosed.

Godwin Gruber, P.C.
801 E. Campbell Rd. Suite 655
Richardson, Texas 75081
(972) 331-1301

Respectfully submitted,

Gary C. Honeycutt
Registration No. 20,250

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Gautam V. Thakar, et al.
Serial No.: 09/939,259
Filed: August 24, 2001

Group Art Unit: 1765
Docket: TI-32822

For: **POLYSILICON PROCESSING USING AN ANTI-REFLECTIVE DUAL LAYER
HARDMASK FOR 193 nm LITHOGRAPHY**

**SUBMISSION OF MISSING PARTS AND
PETITION UNDER 37 CFR 1.47(b)**

Commissioner of Patents and Trademarks
Washington, D.C. 20231

Dear Sir:

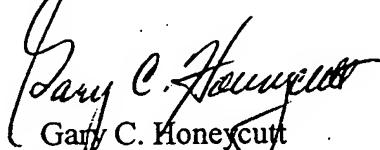
Responsive to the Notice of Missing Parts date October 10, 2001, applicant hereby submits the missing Declaration. One signature is still missing because inventor Laaksonen refused to sign.

A petition under 37 CFR 1.47(b) is also submitted, for the purpose of proceeding without the signature of inventor Laaksonen.

A copy of the Notice of Missing Parts is enclosed.

Please charge Deposit Account No. 20-0668 in the amount of \$130.00 for the oath or declaration surcharge as set forth in 37 CFR 1.16(l). The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 20-0668.

Respectfully submitted,


Gary C. Honeycutt
Reg. No. 20,250

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: **Gautam V. Thakar, et al**
Serial No. **09/939,259**
Filed: **August 24, 2001**

Group Art Unit: **1765**
Docket: **TI-32822**

For: **POLYSILICON PROCESSING USING AN ANTI-REFLECTIVE DUAL LAYER HARDMASK FOR 193 nm LITHOGRAPHY**

PETITION AND STATEMENT OF FACTS - 37 CFR 1.47(b)

Commissioner of Patents and Trademarks
Washington, D.C. 20231

Sir:

Applicants' assignee, Texas Instruments Incorporated, hereby petitions the Commissioner to accept this application, and to issue the patent (if allowed), without the signature of inventor Reima T. Laaksonen, pursuant to 37 CFR 1.47(b).

The proprietary interest in this invention belongs to Texas Instruments, and has belonged to Texas Instruments since the time of its inception. An owner/assignee is entitled to pursue its right to seek a patent, without the signature of a recalcitrant inventor.

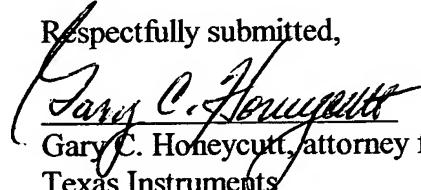
The sole reason expressed by inventor Laaksonen for refusing to sign the application is that his name is not listed first on the Declaration and Power of Attorney, which he believes is inconsistent with his claim to be the primary inventor. But inventor Gautam V. Thakar also insists that he is the primary inventor. Repeated attempts to resolve this dispute have failed.

The proprietary interest of TI is established by inventor Laaksonen's agreement (Exhibit A of the Honeycutt Declaration) wherein he assigned all his interest in the invention to Texas Instruments; and by his disclosure of the invention (Exhibit B) pursuant to the requirements of Exhibit A, while he was an employee of Texas Instruments.

The Rule 64 averments normally required of inventor Laaksonen are made on his behalf by the enclosed Declaration of James Brady, acting for Texas Instruments.

No other facts or averments are known to be relevant. Accordingly, this Petition should be granted in order to avoid irreparable damage to the assignee.

Respectfully submitted,


Gary C. Honeycutt, attorney for
Texas Instruments

POLYSILICON PROCESSING USING AN ANTI-REFLECTIVE DUAL LAYER
HARDMASK FOR 193 nm LITHOGRAPHY
Serial No. 09/939,259, Filed August 24, 2001
Inventors: Gautam V. Thakar, et al.

DECLARATION OF GARY C. HONEYCUTT

- I. I, Gary C. Honeycutt, residing at 4728 Ravendale, Richardson, Texas 75082 make this Declaration in support of the Petition and Statement of Facts under 37 CFR 1.47(b) filed in connection with the above-referenced patent application.
- II. At the time of filing the above-referenced patent application, I was and continue to be an attorney for Texas Instruments Incorporated.
- III. At all relevant times, the proprietary interest in this invention belonged to Texas Instruments Incorporated, 12500 TI Blvd., Dallas, Texas 75243, and continues to belong to Texas Instruments Incorporated.
- IV. The proprietary interest is evidenced by a formal, written agreement whereby the inventor, Laaksonen, agreed to assign the invention to Texas Instruments Incorporated. A true copy of said agreement is attached as Exhibit A.
- V. The accompanying invention disclosure statement is a true copy of the original, which was filled out by the inventors, describing the invention, is attached as Exhibit B and establishes that the inventors were employees of Texas Instruments at the time of the invention. The invention disclosure statement is a document used by Texas Instruments to gain approval for filing the application, pursuant to the inventor's obligations stated in Exhibit A.
- VI. Proof of the need to prevent irreparable damage or preserve the rights of Texas Instruments Incorporated is evidenced by the fact that Texas Instruments is currently using a system as described in said application.

I hereby declare that all statements made herein of my knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date: JAN 10, '02

By: Gary C. Honeycutt
Gary C. Honeycutt
Title: Attorney of Record

EXHIBIT A

(E)

TI-10477D

ASSIGNMENT OF INVENTIONS AND
COMPANY INFORMATION AGREEMENT

In consideration of my employment by Texas Instruments Incorporated or any subsidiary thereof (hereinafter, collectively referred to as "TI"), I hereby agree as follows:

I.
ASSIGNMENT OF INVENTIONS

A. I agree to disclose promptly, completely and in writing to TI and I hereby assign and agree to assign and bind my heirs, executors, or administrators to assign to TI or its designee, its assigns, successors or legal representatives, any and all inventions, processes, diagrams, methods, apparatus, or any improvements (all hereinafter collectively called "inventions") whatsoever, discovered, conceived, and/or developed, either individually or jointly with others, during the course of my employment with TI (including any and all inventions based wholly or in part upon ideas conceived during my employment with TI), or using TI's time, data, facilities and/or materials, provided the subject matter is one within a field of interest of TI. My obligations under this paragraph apply without regard to whether an idea for an invention or a solution to a problem occurs to me on the job, at home, or elsewhere. I further agree that all such inventions are TI's exclusive property, whether or not patent applications are filed thereon.

B. Subject matter within a field of interest of TI includes any field of interest that has been worked on by TI in the past, in which there is work in progress at TI at the date of or during my employment with TI, and projects or other operations at TI planned for the future. It is expressly understood that this agreement does not apply to any of my patents or patent applications filed or based on inventions made prior to my employment with TI or to matters other than matters within a field of interest of TI which are exclusively of personal interest.

C. I shall assist TI at any time during or after my employment is terminated, at TI's expense, in the preparation, execution, and delivery of any disclosures, patent applications, or papers within the scope and intent of this agreement required to obtain patents in this or in other countries and in connection with such other proceedings as may be necessary to vest title thereto in TI, its assigns, successors, or legal representatives. If such assistance takes place after my employment is terminated, I shall be paid by TI at a reasonable rate for any time that I actually spend in such work at TI's request.

II.
COPYRIGHT AGREEMENT

A. I agree that TI shall be the copyright proprietor in all copyrightable works of every kind and description created or developed by me solely or jointly with others during my employment with TI which works are created pursuant to the performance of my duties as those duties may be assigned or reassigned from time to time.

B. I further agree, if so requested and at no further expense to TI, to execute in writing any acknowledgments or assignments of copyright ownership of works within this agreement as may be necessary for the preservation of the worldwide proprietorship in TI of such copyrights.

III.
COMPANY INFORMATION

A. I recognize that my position with TI is one of highest trust and confidence by reason of my access to and contact with the trade secrets and confidential and proprietary business information of TI. I shall use my best efforts and exercise utmost diligence to protect and safeguard the trade secrets and confidential or proprietary information of TI.

B. Except as may be required by TI in connection with and during my employment with TI or with the express written permission of TI, I shall not, either during my employment with TI or thereafter, directly or indirectly, use for my own benefit or for the benefit of another, or disclose to another, any trade secret or confidential or proprietary information (whether or not acquired, learned, obtained or developed by myself alone or in conjunction with others) of TI, its customers, contractors or of others with which TI has a business relationship.

C. I further agree that all memoranda, notes, records, drawings, or other documents made or compiled by me or made available to me while employed by TI concerning any process, apparatus or products manufactured, used, developed, investigated or considered by TI or concerning any other TI activity shall be the property of TI and shall be delivered to TI upon termination of my employment or at any other time upon request.

D. I recognize that TI expects me to respect and safeguard any trade secret and confidential or proprietary information of any former employer, business associate or others and I hereby acknowledge TI's express direction not to disclose to TI, its officers, directors or employees any of such information so long as it remains confidential or proprietary.

IV.
MISCELLANEOUS

A. Nothing contained in this agreement shall be construed as impairing my right or the rights of TI to terminate employment hereunder.

B. My obligations under this agreement shall continue whether or not my employment with TI shall be terminated voluntarily or involuntarily, with or without cause.

C. This agreement shall be binding upon and inure to the benefit of TI, its successors in business and soon me, my heirs, executors and administrators.

D. This agreement replaces all previous agreements relating to the same or similar matters which I may have entered into with TI with respect to my present and any future period of employment by TI. This agreement may not be modified in any respect by any verbal statement, representation or agreement made by any other employee of TI, or by a written document signed by any employee of TI other than an officer thereof.

E. The law of the State of Texas will govern the interpretation, validity and effect of this agreement without regard to the place of execution or the place of performance thereof.

Reima Tapani Laaksonen
Date JAN - 30 - 1995

STATE OF TEXAS
COUNTY OF DALLAS

The above-named REIMA TAPANI LAAKSONEN
personally appeared before me and acknowledged the foregoing instrument to be his
free act and deed.

Re. Sticker
NOTARY PUBLIC
MY COMMISSION EXPIRES: 3/4/99

SEAL

EXHIBIT B

MAV

DISCLOSURE FORM

DOCKET NO.

TI

32822

* IF ELECTRONICALLY TRANSMITTED, *
* PROCESSING OF YOUR DISCLOSURE *
* CANNOT BE COMPLETED WITHOUT *
* A FOLLOW-UP COPY SIGNED AND *
* DATED BY ALL INVENTORS AND *
* AT LEAST ONE WITNESS. *

1. Please suggest a descriptive title for your invention:

**BILAYER SRN/SiON LAYER SANDWICHED BETWEEN POLY AND RESIST LAYER
USED AS INORGANIC-ARC AND INORGANIC HARDMASK FOR POLY PROCESSING**

2. This invention supports strategy: (check 1 or more)

() DRAM

DSPS:

() DLP

(*) Wireless

() Materials

() Video

(*) Fab/Processes

() Set Top

() Assembly/Test/Packaging

(*) Application Specific

() Other

() Remote/Access/Networking

(*) Emerging Markets

(*) Mixed Signal & Logic

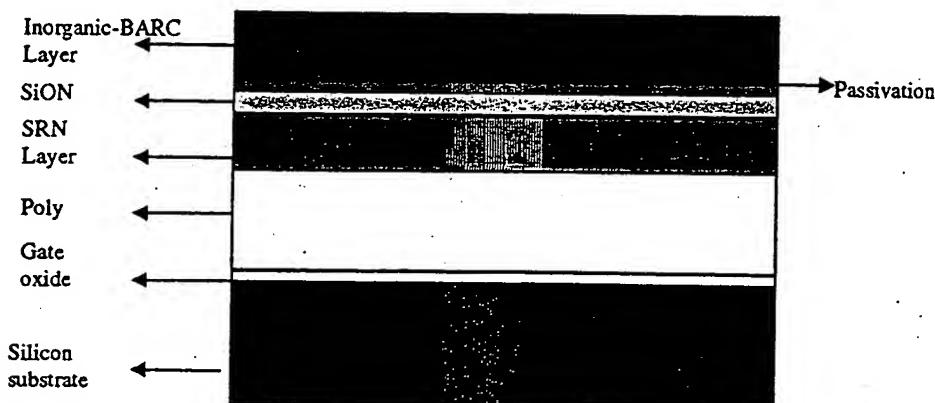
() Mass Storage

(*) Other

3. What is the problem solved by your invention?

We were using SiON inorganic-arc layer for poly processing. The SiON Inorganic-arc gives us an advantage in gaining better CD uniformity at lithography and poly etch process. The drawback is that the selectivity to oxide for H₃PO₄ cleanup used for removal of the inorganic barc layer at post poly etch is not good. It results in adverse effect on doped and undoped poly lines. It could also result in damage to the active area.

SCHEMATIC DRAWING OF THE USE OF SANDWICH SRN-SiON LAYER FOR 193nm PROCESS

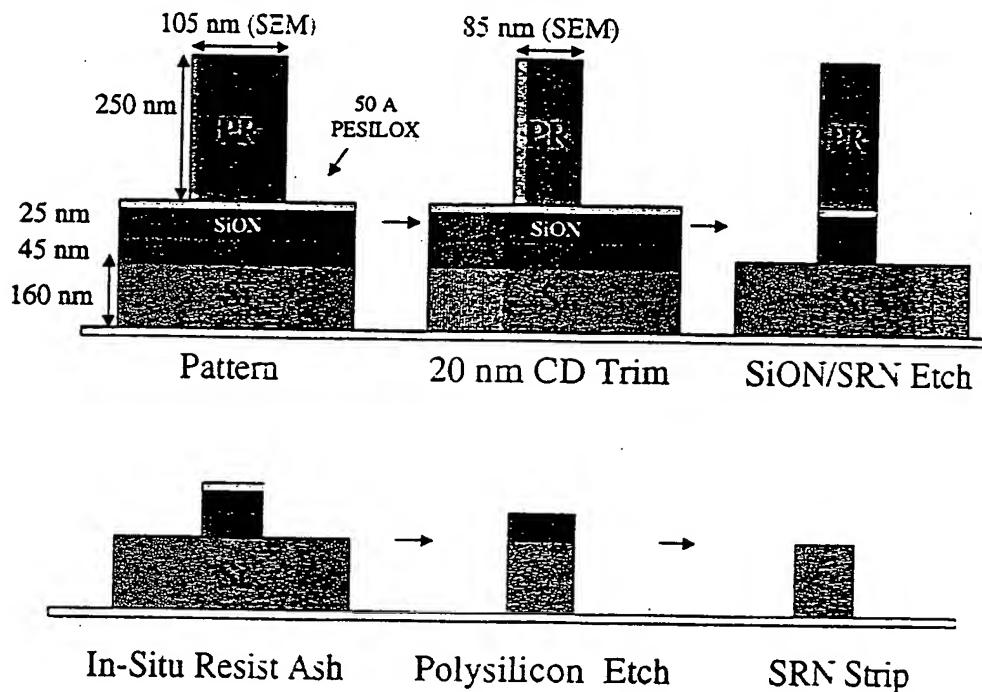


The proposal here discusses the use of SRN layer between poly and SiON layer to improve, the selectivity and process margin at post poly etch cleanup.

4. What is your solution to the problem?

To overcome the problem with process margin and selectivity to poly and oxide during the cleanup, we propose the use of SRN layer between poly and inorganic-barc layer. The SRN layer has better selectivity to H₃Po₄ and helps to reduce the time for the cleanup sequence, which will improve process margin and eliminate the adverse effect of post poly etch cleanup. An example of the bilayer scheme in 193nm poly processing:

C035.B Gate Process Flow



5. When was your solution first conceptually or mentally complete? Date: April / 7 / 2000.
6. What is the first tangible evidence of such completion? Date: August / ___ / 2000. (exact date will be submitted later)
7. What is different about your solution, compared with other solutions to the same problem?

Other attempts have been made: (1) To improve and optimize cleanup process parameters such as temperature, time, chemistry, etc to improve selectivity (2) Use of silox or PSG or BPSG as sandwich layer to reduce post etch cleanup time during inorganic-arc removal but was abundant for various reasons.

8. What are the advantages of your solution?
- (1) The bilayer (SRN/SION) sandwiched between poly and resist layers improved optical properties of the lithography process and CD uniformity.
(2) Better selectivity to post poly etch cleanup process lead to removing the SRN/SION layer without damage to active area and improved process margin. (3) The SRN/SION sandwich bilayer stack is found to be the most optimized stack for 193nm lithography processing.
9. What TI products, processes, projects or operations currently implement your invention?
- The following technologies are currently using this process:
C035.B, C027, SOI, For 193nm lithography and poly etch processes.
10. What is the date of the first implementation? October/_-__/ 2000.
One of the first lot processed (lot-0285377) was on October 19th, 2000
and others lot-024518, 0280071 around October 28th, 2000.
11. What record exists to prove this date?
- Initial C035.B material for device X1640 and X1682 was processed using the SRN/SION bilayer process successfully for 193nm lithography.
Material/Lot numbers available.
12. Is there any future implementation planned? (Y/N).
If so, please furnish the TI PART No. or project name
- Already implemented: See section 10, 11
13. Has the invention been published or disclosed to anyone outside of TI? (Y/N) No When? _____ If planned - when? _____ (Catalog, advertising, data book, application note, conference paper, magazine article, TI TJ, proposal document.) Was there a nondisclosure agreement (NDA)? (Y/N) _____.
14. Has a TI product incorporating the invention been publicly introduced, quoted, sampled or shipped? (Y/N) No When? _____ If planned--when? _____.
{ Currently the SRN/SION bilayer poly process is used in prototype products and will eventually go in production, possibly within 6 months }
15. Was the invention conceived or first implemented in the performance of a government contract or subcontract? (Y/N) NO Contract #: _____

THE INVENTION DESCRIBED BY THIS DISCLOSURE IS SUBMITTED PURSUANT TO
MY EMPLOYMENT AGREEMENT WITH TEXAS INSTRUMENTS INCORPORATED OR A TI
SUBSIDIARY (SPECIFY):

Has this disclosure been previously sent to the Patent
Department electronically (unsigned)? (Y/N) YES.

(Printed) Inventor 1: Gautam V. Thakar

Home Address: 412 Ruidosa Circle

Plano, Texas 75023-4739, Collin
City, State, Zip, and County EMail: thakar@ti.com

Employee #: 0171280 TI Division & Cost Center 03 - 1177

Phone #: (972)-995-9655 Beeper #: (972)- 597-4410. PCDROP: PRE3

Country of Citizenship: U.S.A

(Signed) Gautam Thakar Date: March 17, 2001 3737
Mail Station

(Printed) Inventor 2: Tapani Laaksonen

Home Address: _____

City, State, Zip and County EMail: _____

Employee #: _____ TI Divison & Cost Center ____-____

Phone #: _____ Beeper: _____

Country of Citizenship: _____

(Signed) _____ Date: _____ Mail Station

(Printed) Inventor 3: ~~Mike~~ Cameron Gross

Home Address: _____

City, State, Zip, and County _____ EMail: _____

Employee #: _____ TI Division & Cost Center _____

Phone #: _____ Country of Citizenship: _____

(Signed) _____ Date: _____ Mail Station

(Printed) Inventor 4: Eric Joseph

Home Address: _____

City, State, Zip and County _____ EMail: _____

Employee #: _____ TI Division & Cost Center _____

Phone #: _____ Beeper #: _____

Country of Citizenship: _____

(Signed) _____ Date: _____ Mail Station

This invention disclosure with any attachments was read and understood by me on August 28th / 2000.

Alwin Tsao
Witness 1:

3/26/01
Date

This invention disclosure with any attachments was read and understood by me on September 5th / 2000.

Tad Grider
Witness 2:

3/26/01
Date

*****END OF FORM*****

DISCLOSURE ON THE USE OF SANDWICH SRN LAYER BETWEEN POLY AND INORGANIC-BARC OR HARDMASK BARC LAYER

Introduction:

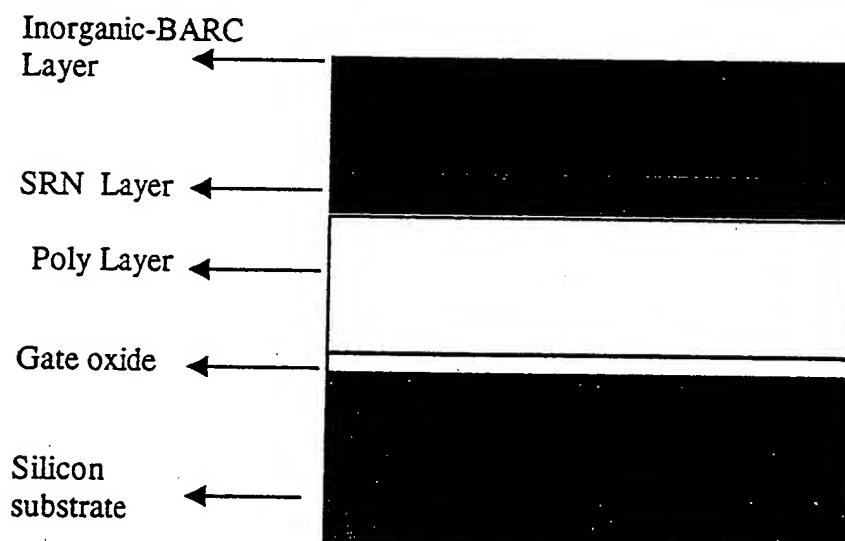
Currently we are using SiON BARC layer for poly processing. The SiON inorganic barc layer gives us an advantage in gaining better CD uniformity at lithography and poly etch process. The drawback is that the selectivity to oxide for H₃PO₄ cleanup used for removal of the inorganic barc layer after poly etch is not good. The cleanup time is large and it results in adverse effect on dope and undope poly lines. It could also result in damage to the active area. The proposal here discusses the use of SRN layer between poly and SiON layer to improve, the selectivity and process margin at post poly etch cleanup.

Sandwich SRN Layer Between Poly and SiON Layers:

To overcome the problem with process margin and selectivity to poly and oxide during the cleanup, we propose the use of SRN layer between poly and inorganic-barc layer. The SRN layer has better selectivity to H₃PO₄ and helps to reduce the time for the cleanup sequence, which will improve process margin and eliminate the adverse effect of post poly etch cleanup.

The concept of using SRN layer as an intermediate layer between inorganic-barc or hardmask and Poly layer to reduce the adverse effects of post poly etch cleanup was first proposed in April 2000.

SCHEMATIC DRAWING OF THE USE OF SANDWICH SRN LAYER



<u>Gautam Thakar</u> Gautam Thakar 8/26/00	<u>Tapani Laaksonen</u> Tapani Laaksonen	<u>Mari Tervo Douglas T. Gude</u> 8/28/00 9/5/00
--------------------------------------------------	---------------------------------------------	--------------------------------------------------------

32903

MAY

2020

PATENT DISCLOSURE FORM

DOCKET NO. TI-(to be filled in by Patent Activity)

**IF ELECTRONICALLY TRANSMITTED, PROCESSING OF YOUR
DISCLOSURE CANNOT BE COMPLETED WITHOUT A
FOLLOW-UP COPY SIGNED AND DATED BY ALL INVENTORS
AND AT LEAST ONE WITNESS.**

1. Please suggest a descriptive title for your invention:

Low reflectivity dual-layer hardmask for 193 nm lithography

2. This invention supports strategy: (check 1 or more)

DLP
 Materials
 Fab/Processes
 Assembly/Test/Packaging
 Other

DSPS
 Wireless
 Video
 Set Top
 Application Specific
 Remote/Access/Networking
 Emerging Markets
 Mixed Signal & Logic
 Mass Storage
 Other

3. What is the problem solved by your invention?

We need a good anti-reflective hardmask for 193 nm lithography. This layer must have good anti-reflective properties at 193 nm wavelength so that we can print lines for the C035.B and more advanced technologies. It must also have such properties that it can survive the etch process. And the film deposition process must be manufacturable i.e. have large enough process window.

Typical anti-reflective coatings are SixOyNz (SiliconOxyNitride) type films. We were able to synthesize SixOyNz films, which had low index of refraction (1.8-1.9) and whose extinction we were able to vary from 0.32 to 0.86. Therefore, they could be used either as anti-reflective coating or as a hardmask at 193 nm. However, the removal of this class of materials is difficult, and the processes tend to cause most recess and also reduce the gate linewidth. Furthermore, it is questionable if we can use SixOyNz as thin ARC layers (typical thicknesses at 193 nm are 250 Å), since to achieve good lithography margin the resist

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thickness must be very small (less than 3000 Å). This is not enough for the etch process. Another kind of ARC materials are SixNy films, which are easier to remove, but their optical constants at 193 nm wavelength are not suitable to be used as ARC layer or as an hardmask layer. We synthesized nine different kinds of SixNy films; all of them had high k value (0.7-1.1) and low n (2.1-2.3) and, therefore, high reflectivity. We also synthesized 17 SixNy films with low k (0.2-0.5) and large n (2.35-2.45). These films had low reflectivity at 500-550 Å thickness, which is not thick enough to withstand the gate etch if the poly thickness is 2500 Å. If thinner poly thickness e.g. 1600 Å is used, then the SixNy thickness may be thick enough to protect the gate during the etch. However, the thickness window was small: +/-25Å.

4. What is your solution to the problem?

By using a dual-layer anti-reflective coating we can reduce the reflectivity to less than 1 % and still have a large ARC film thickness window (region around the reflectivity minimum where the reflectivity remains less than 1 %). This can be achieved if the refractive index (n) and the extinction coefficient (k) of these two layers are matched carefully. The top layer k has to be small (we selected an SixOyNz film whose k was about 0.32) and the bottom layer k has to be large (we selected an SixNy film whose k was about 1.02). This way the total reflectivity is totally independent of the SixNy film thickness, as long as it is more than 300 Å. The SixOyNz film thickness has about +/- 80 Å process window (reflectivity less than 1%). The optimum SixOyNz thickness is about 250 Å. The method is not very sensitive to the bottom layer k value. Our simulations show that materials with k values ranging from 0.77 to 1.07 provide good results. We were able experimentally produce materials whose k value varied within this range. We want to emphasize that the success of the method depends on the top layer k value. We synthesized nine different SixOyNz films; only one of them had low enough k to be used as a top layer in the anti-reflective coating. When we tried to use other SixOyNz films with higher k values (0.52-0.85), they did not give good results. We also want to emphasize that the top layer does not need to be a SixOyNz film or the bottom layer SixNy. Any material with suitable n and k values will work, if it functions as a mask during the etch and if it can be removed in the subsequent processing.

5. When was your solution first conceptually or mentally complete?

Date: Sep-07-2000

6. What is the first tangible evidence of such completion?

Date: Sep-07-2000

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7. What is different about your solution, compared with other solutions to the same problem?

Most other companies use a single material: SixNyO or SiXNy. Most companies use SiXOyNz as a thin ARC layer or as a hardmask. The removal of this kind of coating is difficult due to its chemical properties. Furthermore, it is questionable if a thin ARC layer can be used at 193 nm lithography. To get a large lithography process window the resist has to be thin. However, a thin resist and ARC layer together may not be enough to protect the poly during the etch. Some companies use SixNy for 248 nm lithography. However, the optical characteristics of SiXNy type films make them unsuitable for 193 nm lithography. Some equipment vendors (e.g. AMAT) offer also a dual-layer solution. The top layer is an SixNyOz layer. However, in this case the bottom layer is a doped oxide layer. This makes the after etch film removal easy. However, computer simulations show that the process window for this kind system is not very large due to the optical properties of the bottom (oxide) layer; only certain oxide layer thicknesses are allowed to keep the reflectivity low. Furthermore, a specialized tool is needed to remove the doped oxide.

8. What are the advantages of your solution?

Improves the lithography depth of focus (DOF) since the resist layer can be very thin. The resist ash step before the poly etch can be very short or can be omitted, since the resist layer can be very thin. Furthermore, the hardmask etch, ash and poly etch can be done in-situ in the same chamber. The hardmask deposition process is very manufacturable, since the hardmask thickness window is wide: +/- 70 A for the SxiOyNx layer and SixNy layer can be of any thickness larger than 300 A. The hardmask removal is easy, since the etch process removes the SixOyNz layer whose removal is difficult in the standard post etch clean-up.

9. What TI products, processes, projects or operations currently implement your invention?

C035.B

10. What is the date of the first implementation?

Date: Sep-07-2000

11. What record exists to prove this date?

Computer files that show simulations done on that day. Hardmask deposition recipes on the tool created on that day. Email message sent on Sep-18-2000 shows that the first experiments were done before Sep-18-2000.

12. Is there any future implementation planned?

DK AB

Yes No

If so, please furnish the TI PART No. or project name

Jalapeno chip for SUN Microsystems

13. Has the invention been published or disclosed to anyone outside of TI?

Yes No

When?

If planned - when? November 2001 (Catalog, advertising, data book, application note, conference paper, magazine article, TI TJ, proposal document.)

Was there a nondisclosure agreement (NDA)?

Yes No

14. Has a TI product incorporating the invention been publicly introduced, quoted, sampled or shipped?

Yes No

When? If planned--when? 04-28-2001.

15. Was the invention conceived or first implemented in the performance of a government contract or subcontract?

Yes No

Contract #:

THE INVENTION DESCRIBED BY THIS DISCLOSURE IS SUBMITTED
PURSUANT TO MY EMPLOYMENT AGREEMENT WITH TEXAS INSTRUMENTS
INCORPORATED OR A TI SUBSIDIARY (SPECIFY):

Has this disclosure been previously sent to the Patent Department electronically (unsigned)?

Yes No

RK C.B.

PLEASE PRINT ALL INVENTOR INFORMATION.

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Mail Station: 3701

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Date: APR - 03 - 2001

Mail Station: 3701

~~This invention disclosure with any attachments~~ was read and understood by me on

~~Fitness 1:~~

4/5/2001

Date

This invention disclosure with any attachments was read and understood by me on

Witness 2:

Date

POLYSILICON PROCESSING USING AN ANTI-REFLECTIVE DUAL LAYER
HARDMASK FOR 193 nm LITHOGRAPHY
Serial No. 09/939,259, Filed August 24, 2001
Inventors: Gautam V. Thakar, et al.

DECLARATION BY JAMES BRADY
ON BEHALF OF INVENTOR LAAKSONEN

I, James Brady, hereby declare that:

- I. I am a citizen of the United States, residing at 7504 Hamner Lane, Plano, Texas 75024.
- II. I am the Deputy General Patent Counsel, Manager of Patent Prosecution and Vice President of the Law Department for Texas Instruments Incorporated. As such, I am an officer duly authorized to sign this declaration.
- III. By virtue of the proprietary interest of Texas Instruments Incorporated and my authority to sign this Declaration, I sign this Declaration on behalf of and as agent for Reima T. Laaksonen, who has refused to sign Application Serial Number 09/939,259.
- IV. Upon information and belief, I aver those facts which the inventor is required to state, as set forth in 37 CFR 1.64(b).
- V. Accompanying this Declaration is the Petition and Statement of Facts Under 37 CFR 1.47(b) to establish the proof of pertinent facts.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date: 1/8/02

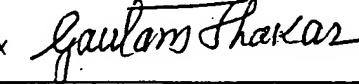
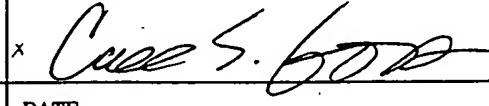
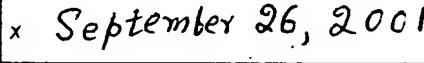
By: James Brady
James Brady
Title: Deputy General Patent
Counsel, Manager of Patent
Prosecution &
Vice President Law

PAGE 1 OF 2

APPLICATION FOR UNITED STATES PATENT
DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I declare that my residence, post office address and citizenship are as stated below next to my name; that I verily believe that I am the original, first and sole inventor if only one name is listed below, or an original, first and joint inventor if plural inventors are named below, of the subject matter which is claimed and for which a patent is sought on the invention entitled as set forth below, which is described in the attached specification of Application Serial No. 09/939,259, filed 08/24/01; that I have reviewed and understand the contents of the specification, including the claims, as amended by any amendment specifically referred to in the oath or declaration; that no application for patent or inventor's certificate on this invention has been filed by me or my legal representatives or assigns in any country foreign to the United States of America; and that I acknowledge my duty to disclose information which is material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56;

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

TITLE OF INVENTION:		
Polysilicon Processing Using an Anti-Reflective Dual Layer Hardmask for 193 nm Lithography		
POWER OF ATTORNEY: I HEREBY APPOINT PRACTITIONERS AT CUSTOMER NUMBER 23494 TO PROSECUTE THIS APPLICATION AND TRANSACT ALL BUSINESS IN THE PATENT AND TRADEMARK OFFICE CONNECTED THEREWITH		
SEND CORRESPONDENCE TO: Gary C. Honeycutt Texas Instruments Incorporated P.O. Box 655474, MS 3999 Dallas, TX 75265		DIRECT TELEPHONE CALLS TO: Gary C. Honeycutt (972) 238-7160
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SIGNATURE OF INVENTOR: 	SIGNATURE OF INVENTOR: 	SIGNATURE OF INVENTOR: 
DATE: 	DATE: 	DATE: 

ATTORNEYS DOCKET NO.
TI-32822

**APPLICATION FOR UNITED STATES PATENT
DECLARATION AND POWER OF ATTORNEY**

TITLE OF INVENTION:

Polysilicon Processing Using an Anti-Reflective Dual Layer Hardmask
for 193 nm Lithography

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COUNTRY OF CITIZENSHIP: United States	COUNTRY OF CITIZENSHIP:	COUNTRY OF CITIZENSHIP:
SIGNATURE OF INVENTOR:	SIGNATURE OF INVENTOR:	SIGNATURE OF INVENTOR:
DATE:	DATE:	DATE:

PAGE 1 OF 2

**APPLICATION FOR UNITED STATES PATENT
DECLARATION AND POWER OF ATTORNEY**

As a below named inventor, I declare that my residence, post office address and citizenship are as stated below next to my name; that I verily believe that I am the original, first and sole inventor if only one name is listed below, or an original, first and joint inventor if plural inventors are named below, of the subject matter which is claimed and for which a patent is sought on the invention entitled as set forth below, which is described in the attached specification of Application Serial No. 09/939,259, filed 08/24/01; that I have reviewed and understand the contents of the specification, including the claims, as amended by any amendment specifically referred to in the oath or declaration; that no application for patent or inventor's certificate on this invention has been filed by me or my legal representatives or assigns in any country foreign to the United States of America; and that I acknowledge my duty to disclose information which is material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56;

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

TITLE OF INVENTION:

**Polysilicon Processing Using an Anti-Reflective Dual Layer Hardmask
for 193 nm Lithography**

POWER OF ATTORNEY:	I HEREBY APPOINT PRACTITIONERS AT CUSTOMER NUMBER 23494 TO PROSECUTE THIS APPLICATION AND TRANSACT ALL BUSINESS IN THE PATENT AND TRADEMARK OFFICE CONNECTED THEREWITH
--------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

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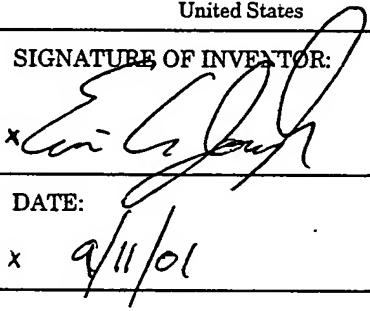
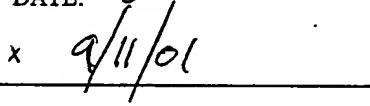
NAME OF INVENTOR: (1)	NAME OF INVENTOR: (2)	NAME OF INVENTOR: (3)
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SIGNATURE OF INVENTOR:	SIGNATURE OF INVENTOR:	SIGNATURE OF INVENTOR:
DATE:	DATE:	DATE:

ATTORNEY'S DOCKET NO.
TI-32822

**APPLICATION FOR UNITED STATES PATENT
DECLARATION AND POWER OF ATTORNEY**

TITLE OF INVENTION:

Polysilicon Processing Using an Anti-Reflective Dual Layer Hardmask
for 193 nm Lithography

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COUNTRY OF CITIZENSHIP: United States	COUNTRY OF CITIZENSHIP:	COUNTRY OF CITIZENSHIP:
SIGNATURE OF INVENTOR: 	SIGNATURE OF INVENTOR:	SIGNATURE OF INVENTOR:
DATE:  x 9/11/01	DATE:	DATE: